Transient gene and miRNA expression profile changes of confluent human fibroblast cells in space

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Microgravity or an altered gravity environment from the static 1g has been shown to influence global gene expression patterns and protein levels in cultured cells. However, most of the reported studies conducted in space or using simulated microgravity on the ground have focused on the growth or differentiation of the cells. Whether non-dividing cultured cells will sense the presence of microgravity in space has not been specifically addressed. In an experiment conducted on the International Space Station, confluent human fibroblast cells were fixed after being cultured in space for 3 and 14 days for investigations of gene and miRNA expression profile changes in these cells. A fibroblast is a type of cell that synthesizes the extracellular matrix and collagen, the structural framework for tissues, and plays a critical role in wound healing and other functions. Results of the experiment showed that on Day 3, both the flown and ground cells were still proliferating slowly even though they were confluent, as measured by the expression of ki-67 positive cells, and the cells in space grew slightly faster. Gene and miRNA expression data indicated activation of NFκB and other growth related pathways involving HGF and VEGF in the flown cells. On Day 14 when the cells were mostly non-dividing, the gene and miRNA expression profiles between the flight and ground samples were indistinguishable. Comparison of gene and miRNA expressions in the Day 3 samples in respect to Day 14 revealed that most of the changes observed on Day 3 were related to cell growth for both the flown and ground cells. Analysis of cytoskeleton changes by immunohistochemistry staining of the cells with antibodies for α-tubulin showed no difference between the flight and ground samples. Results of our study suggest that in true non-dividing human fibroblast cells, microgravity in space has little effect on the gene and miRNA expression. Gene and miRNA expression changes were observed in cells that were confluent, but still proliferating slowly. The faster growth in the flown cells was associated with the activation of NFκB pathways which triggers the expression of several growth factors and the suppression of the cell cycle checkpoint.